prominences are taken only on the edge of the disk; but similar phenomena over the entire face of the sun should be studied systematically every day at enough observatories to escape terrestrial cloudiness; direct radiation measures are still too encumbered with meteorological conditions not fully eliminated, as vapor contents and dust in the upper levels, and transported heat in all levels, to be of primary value at present; the indirect measures of the solar radiation through the magnetic field, whereby the amplitudes change with the variable solar energy, promise the most simple and effective method of observation, as soon as the subject of ionization can be more fully developed in the earth's atmosphere; the temperature, pressure and wind effects at different localities must be studied by practical forecasters, who fully understand this complex train of causes and effects. It may be stated in passing that no important improvements have been made in daily forecasting for 30 years, and the same methods continue in vogue. A change in the scale of verifications, a more or less flexible margin of allowances for errors and successes, present different percentage figures for comparison, but on reduction to the same scale there has been no improvement for many years. We prepared tables for constructing daily pressure charts on the sea level, the 3,500-foot level, and the 10,000-foot level and the mutual relations of the three respective systems of isobars are exceedingly instructive and suggestive. The trend of the upper isobars shows the coming course of the storm tracks in a remarkable manner, and the closed isobars of sea level are usually entirely drawn out on the 2-mile level. Similarly, it is possible to prepare approximate isotherms on these two upper levels, after suitable preliminary studies have been made, and the close relations of these isobars and isotherm upper level charts to the areas of precipitation already studied in part will form the only possible basis for an improved method of forecasting.

The Circulation of the Solar Mass.—The model of the circulation of the earth's atmosphere is the proper analogue for the analysis of the circulation of the matter constituting the body of the sun, if the apparent difficulties in the way of securing the thermodynamic constants in the general equations of motion can be overcome. It is quite evident that the solar circulation is an obverse picture of the terrestrial circulation. If the maximum temperatures in the earth's atmosphere occur in middle latitudes, on the sun the maximum temperatures are probably over the equator and over the poles with a minimum near the sun spot belts. If in the earth's atmosphere the westward drift is in the tropics, in that of the sun it is in the polar regions; if in the earth's atmosphere the eastward drift is in the temperate zones, in the sun's atmosphere it is in the equatorial regions. It will require much labor to work out the problem which is thus stated, but conforming to the probable action of the general equations of motion. It is my purpose to pursue these higher problems in solar physics so far as conditions permit me to do so.

Frank H. Bigelow

Washington, D. C.,
August, 1910

A Zoological Laboratory at Montego Bay, Jamaica, B. W. I.

When in 1891 Professor W. K. Brooks removed the zoological laboratory of the Johns Hopkins University to Port Henderson, near Kingston, Jamaica, he deputed the present writer to visit all the other sites on the coast in search of the best.

It was found that Montego Bay in the western part of the island was an exceptionally promising place for a laboratory, but as there was then no railroad connection to Montego Bay, more accessible regions were preferred, and following the lines of least resistance the laboratory was opened again at Port Henderson in 1893 and in 1896, while in 1897 it was removed to Port Antonio, on the north coast. After this most unfortunate season, which brought with it the deaths from yellow fever of both Professor Humphrey and Dr. Conant, the university sent no more zoologists to Jamaica till the present year, 1910.

Montego Bay being now accessible both by steamer direct from New York, from Philadelphia and from Baltimore, and by rail from Kingston and Port Antonio, six zoologists went to test the advantages of this region, and in a residence lasting through June, July, August and September found it a most desirable location for all kinds of zoological work.

The advantages of this place are largely dependent upon its topography; the contour of the coast and the location of the hills form a large body of water cut off from the trade winds to a large extent but still widely open to the ocean on the north. This calm water is exceptionally favorable for the capture of pelagic life.

A second advantage lies in the fact that all the rocks in the neighborhood are limestone, which forms white sands and clear water, producing conditions much like those in the Bahamas. Yet there are interesting rivers with fresh-water faunas close at hand, but these discharge so that the wind and currents carry all the fresh water to the west and leave the region selected for a laboratory bathed at all times in purest salt water. The remarkable uniformity of the sea is indicated in the following table of observations made at the laboratory landing, for forty-eight hours, continuously, with but few interruptions.

TABLE OF OBSERVATIONS ON SALINITY, TEMPERATURE AND TIDE, IN SEA IN FRONT OF THE LABORATORY, "SNUG HARBOR," MADE BY MR. A. R. MIDDLETON JULY 31–AUGUST 2, 1910, MONTEGO BAY, JAMAICA, B. W. I.

Time of Day	Temperature of Air	Temperature of Water	Salinity Reduced to 15° C.	Depth in Inches
11 a.m.	31+C.	29	1.0275	19
12 noon	32	29	1.0276	19
1 p.m.	33	29	1.0275	20
2 p.m.	33.5	29	1.0276	23
3	32	29	1.0276	25.5
4	33	29	1.0276	29.5
5	31	29	1.0274	33.75
6	29.5	29	1.0273	35
7	28.2	29	1.0273	35.25
8	27	28	1.0273	35.75
9	26	28	1.0272	30
10	25	28	1.0272	25
11	25	28	1.0272	24
12 midnight	25	28	1.0272	23
1 a.m.	24	28	1.0272	22.5
2	23	28	1.0272	22.5
3	23	28	1.0272	23.5
4	22	28	1.0272	24
5	23	28	1.0272	25.5
6	23+	28	1.0272	26
7	25+	28	1.0272	26.5
8	29	28	1.0272	25
9	30	28	1.0272	23
10	31	28	1.0273	21
11	33.5	29	1.0273	19.75
12 noon	34.5		1.0272	19
1 p.m.	33	29	1.0272	20.5
2	33	29	1.0274	21.5
3	32.5	29	1.0276	25
4	32.5	29	1.0276	29.75
5	33	29	1.0274	31.5
6	30.5	28	1.0272	33
7	29−	28	1.0272	35
8	27.5	28	1.0272	35.5
9	26	28	1.0272	32.5
10	25	28	1.0272	31
11				
12 midnight				
1 a.m.				
2				
3	24.5	28	1.0272	23
4	24	28	1.0272	24
5	25	28	1.0272	25
6	26	28	1.0272	25.75
7	26.6	28	1.0272	26.5
8	28	28	1.0272	25
9	29.5	28	1.0272	22.5
10	27.3	28	1.0272	21

In this table the salinities have been reduced by Dr. Caswell Grave, of the Maryland Shell Fish Commission, to a standard

of fifteen degrees centigrade and corrected by a standard salinometer. It shows that pure sea water of uniform temperature can be got at the laboratory at all hours. Taken at the end of July and beginning of August of a reputedly hot summer, it shows the lack of excessive heat by day and the comfortable coolness of early morning. Moreover, it expresses the small range of tide and the occurrence of a main high tide and a lesser tide each twenty-four hours, one rising some sixteen and the other but four inches.

The climatic conditions proved favorable for work; during June, July and August we found the temperature in the laboratory not higher than 86° Fahrenheit by day and falling to 74° or 72° at night, tempered by a strong sea breeze which began from seven to nine in the morning and died away before sunset, and by a gentle land breeze late in the night. Afternoon showers laid the dust and kept the vegetation green upon the rocky hills.

The annual rainfall officially recorded for this locality is a golden mean between the extremes at Port Henderson and Port Antonio, being 55 to 70 inches, while as little as 30 to 35 at the former and as much as 100 and more at the latter region. This rainfall is so distributed that good crops of bananas, cocoanuts, sugar cane and vegetables result. Yet at the same time within a radius of only ten miles the rainfall map shows localities having all the possibilities of the island; a small region with more than 100, a large region with 75 to 95, and small regions near us with 40 to 50 and even 30 to 35 inches of rain annually.

The laboratory was within but a mile of the center of the city of Montego Bay, being in fact within the city limits. This proximity to a very interesting old colonial town of several thousand inhabitants with good shops, fine market, extensive trade and frequent connections with the United States as well as with all parts of Jamaica and with Colon, proved a most decided advantage.

The building rented as a laboratory was a dwelling house known as "Snug Harbor," to the east of the town on the main road to Falmouth and close to the sea. It is so well located for this purpose that it was selected as a favorable site back in 1891 and at present is the more desirable as being fitted by its present owner with screens to keep out mosquitoes and with the conveniences made possible by a city water supply.

However, the chief factor in such a station is the character of the accessible fauna and this was soon found to be on the whole better than in any other part of Jamaica yet tried, though lacking some of the special advantages of the reefs of Port Antonio and the Cays off Kingston.

The strong feature of the fauna is its comprehensiveness, its inclusion of so many diverse ecological areas within reachable limits.

A glance at the map would show that the laboratory while so exposed to the sea as to have *Salpas, Trichodesmium* and the like pelagic forms of life brought to its very doors, is yet close to coral reefs and stretches of clean white sand shore and bottom. The generally precipitous north side of Jamaica that drops in a third of a mile to the hundred-fathom limit and then at once to the two-thousand-fathom ocean bottom offers in Montego Bay somewhat of an exception, since there is here an area a mile wide and broad for dredging and fishing within the hundred-fathom limit.

While the general shore is clean rock or sand, there is a fourth great source of animal life, presented by the mangrove shores that lie at safe but convenient distances to the west and the east, in addition to the

surface fauna, the dredging and the collecting on coral reefs. Most especially favorable are the mangroves of the tortuous passages amidst the Bogue Islands, some twenty minutes from the laboratory with the gasoline launch. This interesting product of the combined action of wind and current upon the material brought in past time to the sea by the Montego Bay River is now a growing addition to the large alluvial plain upon the edge of which the town of Montego Bay stands, and as shown on the map consists of some larger and smaller islands, near a dozen, extending the alluvial deposits to the west under the influence of the trade winds. The mangrove trees covering these islands and the adjacent shores hang their roots into salt water along a total distance of many miles. While some of this expanse of pendant roots is exposed to the fresh waters of the Bogue and Redding rivers and barren of animal life, the major part of the edges of this whole complex of islands offers rich collecting ground comparable to that back of the "Palisadoes" near Kingston. Moreover, the quiet water between the islands, where very deep, is often the abode of swarms of jellyfish and zœas, while the eelgrass shoals have their own sponge, lamellibranch, worm and echinoderm forms.

Added to these four main marine collecting fields are the fresh and brackish water and land faunas easily accessible.

Two rivers within a few miles of the laboratory, with interesting animal life, were navigable for the launch for a mile or so above salt water. The apparent former mouth of one now forms a brackish pond containing a rather unique commingling of both fresh and salt water animals.

Several small streams and springs were accessible, while permanent ponds presented various stages between conditions in the interior and those close to the sea.

On the land the fauna accessible is that of a rather dry rocky coastal ridge of hills, of mangrove swamps, of a rich alluvial plain and of the mountainous interior to be reached by train or wagon. Not to be overlooked are the large caverns with their dense population of bats.

Referring to the fauna more in detail, it may be noted that the surface collecting in the bay was better than at Port Antonio or Port Henderson. *Salpas,* medusæ and especially siphonophores were abundant; larval crustacea, echinoderms, ascidians and molluscs were taken in numbers; the large tornaria larva was exceedingly common, though as yet the adult has not been found there. The water being very pure and free from inshore copepods, the surface material was readily studied.

The reefs are rich in the usual madrepores and porites with a great many hydrocorals, sea fans and other gorgonians with their attendant fishes, molluscs, worms and echinoderms. But owing to the small tide and open nature of the coast the reefs are not as easily worked by wading as are some at Port Antonio, though by patient waiting till the single low tide of the twenty-four hours comes at a convenient time of day very good collecting can be had at the reefs near the laboratory or to the west or to the east.

On the reefs and in the harbor where scattered corals abound many species were taken by a modified pair of oyster tongs and by diving, in which the native fishermen often excel. Some large and interesting sponges were thus obtained as well as a few small ones of commercial significance.

Owing to the great clearness of the water the common water glass or bucket with glass bottom brought the fauna well within observing reach at considerable depths, so that little use was made of the Japanese diving spectacles that enable the

observer to see the bottom fauna very distinctly as long as he can hold his head under water. In some cases these too little known tools were of value and interest, though the extreme prevalence of the spiny sea urchin, *Diadema,* makes one cautious in the use of one's head under water. The presence of stinging corals, sea-scorpions and sea stings also inculcates caution in the handling of dimly seen objects.

On the reef close to the laboratory was found crawling one night the remarkably branched echinoderm *Gorgonocephalus* or *Astrophyton,* rarely seen except in deeper-water dredgings.

The near-by beach (a perfect bathing beach) yielded hippas, and interesting gasteropods, including the carrier shell, *Xenophora conchiliophora,* as well as echinoderms. The rocks at the laboratory were covered with chitons, echini, gasteropods and the active crab *Grapsus grapsus* L., there known as "Bessy lightfoot," while at the boat wharf there, single heads of coral with tubularian hydroids gave witness to the pureness of the water in which bright-colored fish and changing squids made daily journeys and reappearances.

The means at hand for dredging proved inadequate to the deeper parts of the bay, but showed considerable workable areas near shore free from coral heads and inhabited by gasteropods, ascidians and starfish.

The location of the laboratory proved unexpectedly advantageous for the study of tropical fishes and their parasites, since almost all the fish caught for the town daily passed under our eyes. The fifty or so dugout canoes that are seen resting on the sands by their owners' houses in the town all day long are out about the reefs before dawn, when the fishermen haul their traps or fish with hook and line till the rise of the trade wind sends them home directly past the laboratory. Being men of keen observation and knowledge of the natural history of the reefs, and in need of money as well, it was a mutual advantage to have them stop to exhibit both the usual catch and any unusual animal that might else have been thrown back into the sea. Much of the fishing being carried on with traps or pots baited with "sprats," or mashed *Diademas,* not only fish of all kinds, but many crustacea and molluscs are taken and from depths not otherwise easy of access.

As emphasizing the beautiful clearness of the water it may be noted that the fishermen throw their traps into water many fathoms deep with no buoy to mark them, in confidence that from their knowledge of the landscape of the bottom they can find the spot for each of their many traps and then see it well enough to take it up with a hook and line.

The ecological territory consisting of mangrove roots hanging in quiet sea water along the edges of the Bogue Islands is inhabited by vast masses of vegetable and animal life representing all the phyla of the animal kingdom if but few groups of plants. Before the hanging roots have grown down to the bottom they furnish favorable place of attachment for free-swiming larvæ and are soon covered over with fixed growths of oysters, barnacles, sponges, hydroids, algæ and many sorts of simple and compound ascidians that grow into large complex masses near the surface of the water. Amidst these fixed animals wander many strange crabs and active ophiurids and nudibranch and shelled gasteropods. The exact make-up of these complex colonies varies from island to island and from side to side, while some passageways are rich in algæ and in large tubicolous annelids.

The fauna of the Great and Montego

Bay rivers besides some fresh-water and marine fishes was noteworthy for the numbers of the variable snail *Neritina,* and for the striking presence of the marine crabs accustomed to life in pure fresh water, *Sesarma miersii* Rathbun and *Glyptograpsus jamaicensis* (Benedict), together with numerous prawns and shrimp.

Zœas swimming in fresh water a mile above the sea and reared to the adult form in fresh water were novelties here. This adjustment of marine forms to the land is more conspicuous in the common white crab, *Cordesima guanhumi* Latreille, and the famous edible black crab, *Gecarcinus ruricola* (Lin.) and the hermit *Cœnobita diogenes,* all of which invaded the laboratory building at the period of their downward march to the sea to "wash spawn," or let loose their long-carried young as zœas that swim in the sea and ultimately come back to the long adult life on land, in many cases far from the water.

Next in order of prominence about the building are the inevitable lizards with their interesting changes of colors or quick utilization of insect food or strange evening cries. One iguana ten pounds in weight brought back alive seemed to be the last survivor on the Bogue Islands, as the one kept at the Jamaica Institute, Kingston, years since was thought to be the last in that part of the island.

Contrary to expectation, some two or three species of snakes were found, though till recently the island was reputed to have been cleared of serpents, like Ireland, but by the unsaintly mongoose. This creature was as evident as our squirrel, and though intractable as adult, was, we found, easily tamed when captured young.

Neglecting the many interesting birds that abounded on all sides, more attention was given to the common pedipalps, scorpions, centipedes and myriapods and some of the conspicuous insects, including the large cucuyo and many smaller but brilliant luminous beetles.

As an example of the rarity of some animals it may be mentioned that one and only one specimen of *Peripatus* was found. This species has hitherto been known only from two specimens found by Gosse in 1845 near Sav la Mar on the south coast, and about eighty found near Bath in the extreme east of Jamaica by Swainson in 1892 and by Duerden and Grobham in 1901.

Conspicuous throughout all this part of Jamaica are the large nests of termites, and the smaller nests of stinging black ants on trees and fences and many near the laboratory afforded ample material for study.

A chief object of the expedition being to enable the candidates for the Ph.D. degree to become personally acquainted with the fauna of these latitudes as part of their education, much time was spent in general survey of the different ecological regions, but some special problems were attacked.

Such were the locomotion of certain echinoderms; the response of the pedicellariæ to light; the life history of the spiny lobster, *Panularis argos,* and of several crabs, notably, *Mithrax spinississimæ* (Lamarck); the origin of the remarkable phosphorescent areas seen on the sea bottom; the biological value of the light emitted by several marine animals and by luminous beetles; the anatomy and life histories of many parasitic copepods, largely unknown species; the daily rhythms of activity in termite communities; the nature of the responses of termites of one colony to those of another; the concurrence of small size and brilliance of coloring with life in brackish water in the case of the fresh-water *Neritina virginea.*

The six members of the laboratory enjoyed good health during the entire summer

there and returned enthusiastic regarding the advantages of Montego Bay as compared with Port Antonio, Kingston and the Tortugas, where one or another of them had previously worked.

Barring the necessary expense of the long sea voyage, a temporary or a permanent laboratory could be opened at Montego Bay with very small outlay and economically maintained, since labor and the necessities of life produced in the island are cheap and readily obtained. While suitable buildings are few, concrete block construction there has been demonstrated a success by the American consul, so that a permanent laboratory might be rapidly constructed.

E. A. Andrews

THE INTERNATIONAL CONGRESS OF RADIOLOGY AND ELECTRICITY, BRUSSELS, SEPTEMBER 13–15, 1910

Up to the present time two congresses of radiology have been held, the first in Liège, 1905, and the second at Brussels during the past autumn. The second International Congress of Radiology and Electricity opened on September 13 with a large attendance and it was somewhat surprising that subjects so relatively modern as those to which the congress was devoted should have attracted so many interested workers in these special fields. The attendance during the congress approached closely to five hundred and much interest and enthusiasm was shown by those who took part in the many meetings.

Participants in the congress began arriving in Brussels as early as the tenth and at the first formal gathering, a reception held at the Bourse on the evening of the twelfth, the number present had already attained considerable proportions. Many notable scientists from all parts of the world were there, including Mme. Curie, Rutherford, Soddy, Arrhenius, Rieke, Exner, St. Meyer, Rigi, Hahn, Du Bois, Goldstein and others, and in fact the congress was particularly conspicuous in the relatively large number of prominent workers in radiology and electricity that attended. The work of the congress began on Tuesday, September 13, with a meeting at the Palais des Fêtes in the grounds of the exposition, where Professor de Heen, the president, delivered an address, and a number of details in connection with the organization were arranged.

In the afternoon of the same day a very interesting meeting was held in the buildings of the university in which the problems of the nomenclature and standards were discussed. The proceedings were begun by Professor Rutherford, who stated that he had recently compared, by the γ-ray method, the radium standards employed in the leading laboratories of several different countries and had observed very considerable differences, amounting in some cases to 20 per cent., between them. He pointed out the importance of a uniform, international standard by which the results and experiments of workers in all parts of the world might be brought into accord. As the subject of radioactivity had reached a stage of development where accurate, quantitative measurements and comparisons are being constantly made, and as certain radioactive quantities, such as the number of α particles emitted by one gram of radium, the volume of the emanation produced, and the heating effect, can now be determined with considerable precision, it is highly desirable that the necessary information as to the exact amount of radium in any given specimen of the substance should be definitely and readily determinable by different workers. It was therefore suggested that a specimen of the purest obtainable salt of radium should be prepared and accepted as an international standard and that facilities be afforded by which all workers in the science might be able to express their results in terms of that standard. The subject was generally discussed and it was finally decided that a committee, to be appointed by Professor Rutherford and Mme. Curie, should be formed and that this committee should consider the special needs in the matter and determine the conditions under which the standard should